III. *Remarks on the Identity of certain general Laws which have been lately observed to regulate the natural Distribution of Insects and Fungi.* *By W. S. MacLeay, Esq. M.A. F.L.S.*

Read November 5, 1822.

THE naturalists of the present day have in one respect a peculiar claim to the appellation of disciples of Linnæus; inasmuch as they direct their chief attention to what this great master declared to be the end of all his immortal labours in botany. His admirable maxim, that the natural system is the "*ultimus botanices finis*," is now not only universally admitted, but on all sides acted upon. The natural system is in fact not only made the remote consequence, but the immediate aim, of every modern observation in natural history; the rule now being, to commence with supposing nothing known but what has actually been observed, and by comparing the affinities thus collected, to search after that knowledge of natural groups which in the old methods we started with supposing to be already acquired. They who formerly confined themselves to artificial systems, and neglected the above important maxim of Linnæus, have at least thereby lost much gratification, since, if there be nothing within the whole range of human science more worthy of profound meditation than the plan by which the Deity regulated the creation; so most assuredly no study is more calculated to administer pure and unmixed delight. Thus, for example, the satisfaction of the mere gazer at a collection of animals

animals must evidently be inferior to that experienced by the comparative anatomist, who understands their respective structures. And again, the anatomist himself, on viewing a museum, can scarcely be so much gratified by the sight, as that naturalist who, not content with a bare and in some degree insulated knowledge of particular organizations, endeavours to comprehend how these harmonize with the rest of the creation. It is in this last mode alone, if I may so express myself, that the human mind can take, as far as its imperfect nature will permit, a view of the universe as it was originally designed. Nor ought any person to be deterred from commencing so delightful a pursuit, either by the supposed difficulty of the investigation, or by the extent of preparatory information which it necessarily requires: for truly has it been said, that he who questions his abilities to arrange the dissimilar parts of an extensive plan, or fears to be lost in a complicated system, may yet hope to adjust a few pages without perplexity.

Having such ideas both of the dignity of natural history and of the importance and feasibility of a more extended research into the natural system than has yet been made, we can scarcely fail to be interested by a late work*, of which the perusal has induced me to address this learned body. Although this work is confined to a department of botany not very generally studied, its author has evidently not been satisfied with the specific discrimination of the imperfectly organized subjects of his research, but has earnestly sought to discover the relations which they bear to each other. Keeping this object steadily in view, M. Fries has been able to give so connected and symmetrical an outline of what he considers to be the natural distribution of *Fungi*, as, at

* *Systema Mycologicum* sistens Fungorum Ordines, Genera, Species, &c. quos ad Normam Methodi Naturalis determinavit, disposuit atque descripsit Elias Fries, &c. vol. i. Gryphiswaldiæ, 1821.

least

least in my opinion, to merit the careful attention of zoologists as well as botanists. It will readily be imagined that, in saying this much, I do not, in the presence of so many more able judges, presume to advance any positive opinion on his merits as an observer. I confine myself entirely to that theory or reasoning founded by M. Fries upon the general result of observations, which it would be impossible to suppose altogether incorrect, even if his reputation as a cryptogamist were less than it really is. On this head, however, I have to remark that our author, although undoubtedly an original observer, is neither the first who has advanced this theory, nor do *Fungi* compose the only part of organized matter in which this sort of arrangement has been conceived to exist. So that even with respect to his theory I may be a partial judge, and may probably be more inclined to admit the validity of his conclusions, than will be deemed prudent by others who are altogether unprejudiced.

M. Fries justly remarks, that the notion of the celebrated Bonnet, as to the existence of a simple series or chain of natural affinities, has been long exploded. The truth however is, that the law of continuity has been quite misunderstood both by Bonnet, and his opponents, so far as organized matter is concerned: for Bonnet fancied that, if affinities were continuous, the series must therefore be simple: and some modern naturalists finding by experience the series not to be simple, therefore supposed that affinities could not be continuous, but that nature presents to the view a mass of unconnected groups, in which it would be a waste of time and a loss of labour to search for any general plan. It does not however appear that either of these inferences has been very philosophically drawn; for there is a certain rule in natural history which originates solely in observation, and which, if properly followed up, will infallibly induce

induce us to grant to Bonnet the truth of his proposition, that affinities are continuous, and yet to agree with his opponents that the series of natural beings is not simple. This rule is, that *Relations of Analogy must be carefully distinguished from Relations of Affinity;* for, as our author M. Fries most truly says, "*Quo magis in superficie acquieverunt naturæ scrutatores, eo magis analoga cum affinibus commutârunt.*"

The ideas of affinity and analogy are so distinct from each other in the mind of every person acquainted with the first principles of logic, that even while this distinction was not laid down as an axiom in natural history, experienced naturalists perceived that every correspondence of character did not necessarily constitute an affinity. Thus the celebrated Pallas, in his *Elenchus Zoophytorum*, has well observed that Bonnet, in order to complete his linear scale of nature, was obliged to abandon the true vinculum of affinity, and to resort to such superficial or analogous characters as those which connect *Vespertilio* and *Exocætus* with birds. But the nature of the difference which exists in natural history between affinity and analogy, was I believe first discovered in studying Lamellicorn Insects; and in the year 1819, when I published that discovery, the fifth part of an acute philosophical work, entitled Botanical Aphorisms*, appeared in Sweden, wherein the distinguished cryptogamist M. Agardh proves by the following words, that he likewise had a slight glimpse of the same truth: "Analogia quædam et similitudo in diversis seriebus vegetabilium interdum cernatur, quasi progressa esset natura ad perfectionem per eosdem gradus sed diversâ viâ.†"

The

* *Aphorismi Botanici,* quos veniâ Ampliss. Ord. Philos. Lund. Præside Carolo Ad. Agardh, &c. pro Gradu Philosophico, p. p. N. Kuhlgren, &c. p.v. Lundæ, 1819.

† In the same little tract M. Agardh makes two other observations, which coincide with what I have noticed in the Animal kingdom. The first is as follows: "Inter inferiores formas superiores sæpe efflorescunt, sed rudes et veluti experimenta; sic anti-

The next work in which the distinction appeared was the *Mémoires du Muséum d'Histoire Naturelle;* in a part of which, published in the autumn of 1821, a paper was inserted by M. Decandollé on the natural family of *Cruciferæ*. Here this botanist states, that he finds it possible to express in a table all the affinities existing in this family of plants by what he terms a *double entrée;* in other words, he supposes that there are transversal affinities as well as direct ones,—a notion of the reality however which appears to be much more confused than that previously entertained by M. Agardh and explained as above in his Botanical Aphorisms.

In the same year (1821) likewise appeared the abovementioned work of M. Fries on *Fungi*, which is explicit on the subject, and wherein the very same expressions of affinity and analogy are used to designate these different relations, which I had applied to them two years before in treating of Lamellicorn Insects*. The

cipationes formæ perfectioris in plantis inferioribus non raro obveniant; ut etiam in plantis superioribus regressus ad formam imperfectiorem." Now in the *Horæ Entomologicæ*, p. 223, I have attempted to show that Nature, in the imperfectly constructed *Acrita*, sketches out in a manner the five principal forms of the animal kingdom. So also the direct return of Annulose *Vermes* to *Acrita* is repeatedly asserted in the same work: this however seems to depend more properly on M. Agardh's other observation, viz. "Duplex est itaque affinitas plantarum, aut ea, quæ oritur e transitu ab unâ formâ normali ad alteram, aut ea, quæ versatur imprimis in anticipatione formæ superioris aut regressu in formam inferiorem. Illam affinitatem *transitus* appellamus, hanc *transultationis*." This affinity of *transultation* is evidently nothing else than the disposition observable in opposite points of the same series or *transitus* of affinity to meet each other, and of which I have given various examples in the *Horæ Entomologicæ*, p. 319.

* I owe my acquaintance with these several works, as well as much information on points of which I should otherwise have been totally ignorant, to the friendship of the consummate botanist, in whose possession the Banksian Library has been so worthily deposited. The second part of the *Horæ Entomologicæ* was published in April 1821. On the 24th of the following month I first saw a copy of M. Decandolle's paper, which was not published till some weeks after; and in the course of last winter I first

The theoretical difference between affinity and analogy may be thus explained*: Suppose the existence of two parallel series of animals, the corresponding points of which agree in some one or two remarkable particulars of structure. Suppose also, that the general conformation of the animals in each series passes so gradually from one species to the other, as to render any interruption of this transition almost imperceptible. We shall thus have two very different relations, which must have required an infinite degree of design before they could have been made exactly to harmonize with each other. When, therefore, two such parallel series can be shown in nature to have each their general change of form gradual, or, in other words, their relations of affinity uninterrupted by any thing known; when moreover the corresponding points in these two series agree in some one or two remarkable circumstances, there is every probability of our arrangement being correct. It is quite inconceivable that the utmost human ingenuity could make these two kinds of relation to tally with each other, had they not been so designed at the creation. A relation of analogy consists in a correspondence between certain parts of the organization of two animals which differ in their general structure. In short, the test of such a relation is barely an evident similarity in some remarkable points of formation, which at first sight give a character to the animals and distinguish them from others connected with them by affinity; whereas, the test of a relation of affinity is its forming part of a transition continued from one structure to another by nearly equal intervals. As a relation of analogy must always depend

first saw Agardh's paper and the work of M. Fries on Fungi. If M. Fries borrowed from his master Agardh the idea of distinguishing affinity and analogy, which is not improbable, we must at least allow him the merit of having greatly improved this part of the theory.

* See *Horæ Entomologicæ*, p. 362 *et seq.*

on some marked property or peculiarity of structure, and as that of affinity, which connects two groups, becomes weaker and less visible as these groups are more general, it is not in the least surprising, that what is only an analogical correspondence in one or two important particulars, should often have been mistaken for a general affinity.

M. Fries draws the distinction between them precisely in the same way, and, making allowance for the difference of the objects he was investigating, almost in the same words: "Natura tamen, ubique varia, semper tamen eadem, hoc est, eandem ideam exponere tendit, mutatis modo, quæ ex ulteriori ratione necessario pendent; eadem sequitur principia, ita modo ut inferiora (v. g. exterior forma, quæ in infimis adhuc vaga) superioribus cedant. Errant igitur qui distinctiones summas e formâ exteriori tantum ducunt; quis ex hac regnum animale et vegetabile definire potuit? Evidentissimè hoc demonstrant Lichenes et Fungi. Recentiores horum differentiam in characteribus externis tantum ponentes cum Fungis jungere voluerunt *Leprarias*, *Opegraphas*, *Calicia*, *Verrucarias*, &c. quod nullo modo probare possum. Altius illorum differentia deducenda. Sed cum natura eâdem viâ inter Lichenes et Fungos ubique progreditur, singulum genus Lichenum Fungis correspondet. At hæc inde *affinia* non dicimus; sed *analoga*.

"*Affinia* igitur sunt quæ in eadem serie sequuntur et in se invicem transire videntur. Hæc in ulterioribus congruunt sed in citerioribus rationibus differunt. *Analoga* autem dicimus quæ in diversis seriebus locis parallelis* posita sunt et sibi invicem corre-

* As there is some danger of being led astray by our imagination when we first attempt to separate relations of analogy from those of affinity, it is fortunate that the naturalist cannot have a more admirable test of his accuracy, or a stronger rein on his fancy, than this parallelism of analogous groups in contiguous series of affinity. Thus, although

correspondent. Ultima cosmica momenta differunt, sed citeriora congruunt, quæ in habitu externo et characteribus accidentalibus mutandis maxime valent. Ubicumque in Historiâ naturali oculos convertimus, singulum organismum multiplicia hujus offerunt exempla. Systema mycologicum infra explicatum his omnino nititur. *Clavaria* et *Peziza*, *Biatora* et *Bæomyces* affines sunt; sed *Clavaria* et *Bæomyces*, *Peziza* et *Biatora* analogæ, *e. s. p.* in infinitum.

"Comparatio Linnæana affinitatis plantarum cum mappâ geographicâ haud ignobilis visa fuit; ignoscatur igitur mihi hanc ita extendenti, ut affinitas in hac indicet longitudinem et analogia latitudinem.

"Neque hoc tantum in inferiores classes quadrat. Naturæ leges ubique harmonicæ. Si systema mycologicum et principia, quibus nititur, omnibus non displicerent, totius regni vegetabilis dispositionem demonstrare conabor. Plurima jam elaboravi."

Relations of affinity being thus separated from those of analogy, we immediately get the following facts from the observation of what M. Agardh terms the affinity of *Transitus*, namely, that species form the only absolute division in nature, and that no groups of species (whatever may be the rank of these groups) ought to be considered as insulated, but only as series of affinities returning into themselves, and forming as it were circles which touch other circles. Such only are natural groups. This was said of Insects*; and our author, looking only at plants, and principally at *Fungi*, comes to the same conclusion, as appears from the following words: "Species unica in naturâ fixè circumscripta idea. Superiores nullas agnovimus sectiones

although a solitary resemblance may mislead, it is clear that when we find several of such resemblances to keep parallel to each other in contiguous series, we may reckon upon their having some more solid foundation than our own fancy.

* *Horæ Entomologicæ*, p. 459 &c.

strictissimè

strictissimè circumscriptas, tantum circulos plus minus clausos, affines vero ubique tangentes. Hos tribus, genera, sectiones, &c. simulque si naturæ vestigia sequuntur, naturales dicimus."

That the circle, indeed, is not always closed or complete has been observed likewise in the animal kingdom; and there are two ways of accounting for it. First, that the beings which would render the circle complete have not yet been discovered; a conclusion to which we readily arrive on considering how little is yet known of natural productions; and secondly, that there are *hiatus* or chasms which do really exist in nature, and which may be attributed to the extinction of species in consequence of revolutions undergone by the surface of this globe. Whether one only or both of these reasons be requisite to account for circles of affinity not always appearing complete, we shall not at present investigate; contenting ourselves with the undoubted fact, that *hiatus* or chasms are everywhere in nature presenting themselves to the view. But this truth by no means contradicts the Linnean maxim, that no *saltus* exists in nature, although such has been esteemed its effect by certain naturalists who have been in the habit of taking the words *hiatus* and *saltus* as synonymous terms*. Thus the series of the *Systema Naturæ* and of the *Règne Animal* is not natural where the *Cetacea* intervene between Quadrupeds and Birds, but is perfectly consonant with nature where the Tortoises are made to follow these last. In the first case, there is a *saltus* or leap from Quadrupeds to Birds over a group totally dissimilar to the latter; there is, in short, an unnatural interruption of the law of continuity, which shocks not merely the naturalist but the ordinary observer. In the

* It is to be regretted that Professor Dugald Stewart should have been led into this common error, and thus have acquired a somewhat erroneous notion of the law of continuity as it refers to natural history. See the second part of his admirable Dissertation, as prefixed to vol. v. of the *Supplement* to the *Encyclopædia Britannica*.

other

other case there is only an *hiatus* or chasm, which the discoveries of a future day may fully occupy. Speaking therefore theoretically, it may be affirmed that a *saltus* never did exist in nature; and it also may be argued, with great appearance of truth, that if the *hiatus* are real which so commonly occur in nature, they did not always exist; or, in short, as M. Fries expresses himself, "*Omnis sectio naturalis circulum per se clausum exhibet.*"

Now this definition of a natural group could never have been given by any person who was not aware of the distinction to be made between affinity and analogy. But whenever two parallel series of objects linked by affinity are drawn up in array, the connexion of their extremes, that is, the formation of the circle, becomes in that very moment, so far as I have observed, more or less conspicuous.

It follows, moreover, from admitting the existence of analogical relations, or, in other words, from laying down the parallelism of groups in different series of affinity, that the number of groups in these series must be the same. For were it otherwise, as for instance, supposing three groups to exist in one complete series, and four in another, it is clear that the parallelism could not exist. But if this parallelism be real, which has been, as shown above, asserted independently of each other by several naturalists acting in different branches of natural history, then the number of groups of the next lower order composing a group of a given degree must be determinate. And if, moreover, we accord to our author the accuracy of the following rule, namely, "Nunquam negligendum, unumquodque regnum, ordinem, genus, &c. in systemate ut individuum esse sumendum;"—in other words, that class bears the same relation to class which order does to order, and genus to genus; then the number of groups composing *any* group of the next higher degree

degree must be determinate; and it only remains for the naturalist to discover from observation what this number is.

That Nature has made use of determinate numbers in the construction of vegetables has long been known empirically; as for instance, where botanists have found the typical number of parts of fructification in the acotyledonous plants of Jussieu to be two, that in monocotyledonous plants to be three, and that in dicotyledonous plants to be five, or multiples of these numbers. Consequently the existence of a determinate number in the distribution of the plants themselves might have been argued *à priori*. And in this manner indeed M. Fries appears to have argued; for it is tolerably clear that it was the consideration of the foregoing rule, adopted by Nature in the structure of acotyledonous plants, which induced him theoretically to assume four as a multiple of two to be the determinate number in which *Fungi* are grouped*. I say this, because he is obliged from actual observation to admit that of these four groups, one is excessively capacious in comparison with the other three, and is always to be divided into *two*. So that we may either, with M. Fries, consider every group of *Fungi* as divisible into four, of which the largest is to be reckoned as two,—a supposition that would not only make two determinate numbers, but which, from the binary groups not being alway analogous, will moreover break the parallelism of corresponding groups,—or we may account every group as divisible into five, and thus not only agree with M. Fries's observations, but besides keep the parallelism of analogies uninterrupted. If in this state of the matter it could now

* It ought here to be observed, that Ocken had previously advanced the opinion that four was the determinate number in natural distribution. This naturalist, however, having in his *Natúrgeschichte für schulen*, lately published, in a great measure abandoned the number four for five, and that more especially in the animal kingdom, has thus got into all the difficulties which necessarily attend the supposition of two determinate numbers.

be

be shown, that in the animal kingdom the same law is followed by nature; in short, to take an instance, if it could be proved that the *Annulosa* may either be divided into four groups, viz. *Ametabola*, *Crustacea*, *Arachnida* and *Ptilota*, where this last is remarkably capacious and divisible into two natural groups, viz. *Mandibulata* and *Haustellata*, or that annulose animals may be divided at once into five groups of the same degree, but of which two have a greater affinity to each other than they have to the other three—if, I repeat, this could be proved, should we not be justified in affirming that the rule, so far as concerns Insects and Fungi, is one and the same? The possibility of thus distributing the annulose animals has, however, been demonstrated already in the *Horæ Entomologicæ;* and it is the way in which we ought to take the rule that only now remains to be investigated. In short, since only two methods* have yet been found to coincide with facts as presented by nature, the question is, whether we ought to account *Fungi* as divisible into five groups, or into four of which one forms two of equal degree. Now I think it may without difficulty be shown, from our author's own observations and rules, that there is only one determinate number which regulates the distribution of *Fungi*, and that five is this number.

* The number seven might also perhaps, for obvious reasons, occur to the mind, were it allowable in natural history to ground any reasoning except upon facts of organization. The idea of this number is however immediately laid aside, on endeavouring to discover seven primary divisions of equal degree in the animal kingdom. It is easy, indeed, to imagine the prevalence of a number; the difficulty is to prove it. The naturalist, therefore, requires something more than the statement of a number, before he allows either a preconceived opinion or any analogy not founded on organic structure to have an influence on his favourite science. He requires its application to nature and its illustration by facts. As yet, however, no numbers have been shown to prevail in natural groups but five, or, which is the same thing, four of which one group is divisible into two. Perhaps, indeed, the most clear method of expressing ourselves on this subject is to say that, laying aside osculant groups, every natural group is divisible into five, which always admit of a binary distribution, that is, into two and three.

In the first place, M. Fries lays it down as a rule, which is quoted above, that he admits no groups whatever to be natural unless they form circles more or less complete. Let us then apply this rule to what he terms his central group, and which he makes always to consist of two. Does this form a circle? If not, the group cannot be natural according to his own definition.

If, on the other hand, its two component groups are each circles, then these are natural. Thus the *Ptilota* will not form one circle, but two; consequently they form two natural groups, which is furthermore proved by their parallel relations of analogy. If we turn to Fungi also, the *Hymenini*, according to M. Fries, do not form one circle, but two; one of *Pileati*, the other of *Clavati;* so that instead of the *Hymenomycetes* forming four natural groups, viz. *Sclerotiacei*, *Tremellini*, *Uterini*, and *Hymenini*, they form, if our author be correct, five; viz. *Sclerotiacei*, *Tremellini**, *Uterini*, *Pileati*, and *Clavati*.

But, to understand this still better, we had as well perhaps enter a little deeper into our author's theory. Every group, he says, which expresses well the character of the superior group to which it belongs, is called the *centrum;* by this, not meaning the centre of a circle, but the site of the normal form or perfection of the particular structure common to the superior group, of which it forms a part. The word *perfection*, even as here used, requires explanation; for it does not, as might be supposed, in this place signify affinity to any particular group. Our author, on the contrary, most properly says, that the idea of perfection in structure has nothing to do with affinity†. "Ipsa hæc affinitas

* This appears to be one of those interesting groups which connect the least perfectly organized beings with those which are the most perfectly organized. In the department of *Hysterophyta* it is to the *Coniomycetes* or lowest *Fungi*, what in the animal kingdom the *Vermes* are to the *Acrita*.

† To the general observations on this subject, as connected with the animal kingdom,

tas imperfectionem potius indicat; perfectissima enim sunt in quâvis sectione ab omnibus aliis remotissima. Sic perfectissima animalia et vegetabilia, quæ maxime a se invicem remota; infima, quorum limites confluunt." Hence it follows, that the *centrum*, or perfection of a group, is in fact that part of the circumference of the circle of affinity which is farthest from the neighbouring group, and exactly the same thing with what in the *Horæ Entomologicæ* has perhaps more happily been called *Type*.

Indeed the confusion arising from the use of the word *centrum*, as applied to a point in the circumference of a circle, is still increased by applying the word *radii* to those groups likewise in the circumference which lead from one centrum or type to another, and which I have termed *annectent groups**. The use of these terms *centrum* and *radii* is the more unfortunate, as our author never for a moment takes them in any other sense than that in which I have used the expressions *type* and *annectent groups*. When, therefore, he says that in every group, whether class, order, &c. there are a *centrum* and *radii*, we must understand him as meaning, that there are in every circle first a *type* or normal form expressing the perfection of the superior group to which it belongs; and secondly, *annectent groups* connecting this type with other groups. Or, to take his own words, "In *centrum* quod

dom, which I have given in *Horæ Entomologicæ*, p. 205, I may add the botanical authority of Professor Schweigger. "Nec etiam genera et ordines plantarum in lineam a cryptogamicis ad dicotyledoneas progredientem ita disponi possunt, ut familia quævis præcedentis structuram magis evolutam præbeat. Vix ullus de vegetabilium serie usitata, a cotyledonum numero deducta, affirmat, plantas dicotyledoneas omni ratione monocotyledoneis esse anteponendas." p. 6. *De Plantarum classificatione naturali Disquisitionibus Anatomicis et Physiologicis stabilienda Commentatio, Auctore A. F. Schweigger, &c. Regiomonti* 1820.

* There are several other terms used by M. Fries to designate his groups, and which differ from those employed by me to express the nature of similar groups. Thus, his *intermediate genera* are my *osculant genera*; his *subordinate genera* are my *types of form* or *sub-genera*, &c.

species plurimas continet, character optime quadrat. *Radii* ad reliquas classes (scilicet ordines, genera, &c.) abeuntes, utriusque classis characterem conciliant, sed ad illam (viz. the typical group) cujus character maxime eminet referuntur."

If then the determinate number in which *Fungi* are naturally grouped be four, and if it thus appears that, according to M. Fries, every natural group is a circle, having in its circumference a point of perfection or typical group called a *centrum*, and annectent groups called *radii*, it is evident that there must be one centrum and three radii for every group. But observe what immediately follows as the result of M. Fries's observation: "*Centrum* abit semper in duas series, inferiorem et superiorem, quarum illa ad antecedentem hæc ad sequentem classem (l. radium) evidentius accedit."

This rule being determined, M. Fries goes on moreover to say, that these two series which compose the *centrum* are always analogous at their corresponding points. Consequently, in every circle he admits the existence of two central groups and three radial; that is, in all, five natural groups. Now this truly is the case throughout the whole animal kingdom. Organized matter is the *centrum* of matter, and is composed of animals and vegetables. *Articulata**, or animals possessing an articulated axis, form the centrum of the animal kingdom, and are composed of *Vertebrata* and *Annulosa*. The *Ptilota* of Aristotle, or winged insects, form the centrum of the *Annulosa*, and are divided into *Mandibulata* and *Haustellata*. And so on, we shall ever find a natural group to be a circle of five minor groups, and that two of these minor groups form what M. Fries would call a *centrum*, or, more correctly, have some character in common which distinguishes them from the other three. That neither of these groups, viz. organized

* This name has been applied to the *Annulosa*, as characterizing them alone, but improperly, inasmuch as the vertebrated animals are articulated.

matter,

matter, *Articulata* or *Ptilota*, is a circle, must be obvious to every observer; and consequently they do not fall within the sphere of M. Fries's definition already given of a natural group, but each of them form two circles, which therefore, according to our author, are natural groups. We might turn even to the well-known great division of the vegetable kingdom into phænogamous or cotyledonous and cryptogamous or acotyledonous plants, where the former are clearly the *centrum*, and divisible into two natural groups; but surely enough has been said to show, that the notion of M. Fries on this head is in every respect, but the mode of expressing it, the same identically with mine. When he states the determinate number to be four, and we investigate the signification attached by him to this proposition, we discover that it is in effect five. How M. Fries was led to the number four, we have already endeavoured to explain; and it is truly worthy of observation, as an almost conclusive argument for the determinate number being five, that M. Fries himself is at last obliged to adopt it. This open abandonment of his theoretical number *four*, which we have seen that he had virtually abandoned before, takes place moreover in that part of his work which, relating to the more minute groups, is therefore most independent of theory, and most subjected to the keenness of practical observers. Here, in brief, he finds himself tied down to stubborn facts, and it is rather interesting to mark the result. The only genera of *Hymenomycetes Pileati* which he discovers to be divisible are, *Agaricus*, *Cantharellus*, *Thelephora*, *Hydnum*, *Boletus*, *Polyporus* and *Dædalea*, some of which, as *Agaricus*, are, as he says, of the first dignity; others, as *Cantharellus*, of the second*. Now every one of these genera, or at least their typical groups, are divided by M. Fries himself into five, with the

* The groups here said to be of the second dignity, appear to be of the same degree with the genera *Phanæus* and *Scarabæus* of the *Horæ Entomologicæ*.

single

single exception of *Cantharellus;* and so truly natural or dependent upon relations of analogy are these five subdivisions, that he proposes to make use of one set of names for all, and in fact does in general make use of the same name for analogous groups*. Nay more: when he has divided the well-known genus *Agaricus* into *five* natural series, he observes, "Singula series a naturâ fixè determinata clausa est reliquis parallela. Tribus diversarum serierum analogas diu eodem nomine salutavi." So that *Agaricus* is, according to the confession of M. Fries, formed of five natural series each closed up; in other words, each a circle, and corresponding at their parallel points to such a degree, that he declares it possible to assign the same names to the analogous groups.

It were tedious to proceed much further on this subject; and therefore, without entering into the speculations, often unintelligible and always vague, of Plutarch, Sir Thomas Brown, Drebel, Linnæus and others, as to the doctrine of *quintessence* generally, we may at once set forth the last argument which shall now be produced for the existence of a quinary distribution in organized nature. It may be stated thus: In the year 1817 I detected a quinary arrangement† in considering a small portion of coleopterous insects; and in the year 1821 I attempted to show that it prevailed generally throughout nature. In the same year (1821), and apparently without any view beyond the particular case then before him, M. Decandolle stated the natural distribution of Cruciferous plants to be quinary. And again, in the same year, a third naturalist, without the knowledge of either Decandolle's *Mémoire* or the *Horæ Entomologicæ*, and in a different part of Europe, publishes what he considers to be the natural arrangement of *Fungi*. Arguing *à priori*, this third natu-

* These five names are, *Mesopus, Pleuropus, Merisma, Apus,* and *Resupinatus.*

† Published in 1819.

ralist

ralist fancies that the determinate number into which these acotyledonous plants are distributed ought to be four; but finds it necessary, in order that it may coincide with observed facts, to make it virtually five. Nay, at last, in spite of the prejudice of theory, he is unable to withstand the force of truth, throws himself into the arms of Nature, and declares that where he actually finds his natural group complete in all its parts, there the determinate number is *five*.

Now, on considering that his work was given to the world two years after the first part of the *Horæ Entomologicæ*, it is clear that, had M. Fries fixed at once on the number five, there might have been room for supposing, that he had not altogether trusted to his own observation, but had borrowed the idea of a quinary distribution. As matters however at present stand, this supposition cannot for a moment be harboured; and I cannot help rejoicing that the strength of this beautiful theory should be so completely brought home to the conviction of every mind, as it must be, by observing the manner in which different persons have respectively stumbled upon it in totally distinct departments of the creation. We may all possibly be wrong in part, or even in much of our respective details; but however this may be, it is difficult not to believe that we are grasping at some great truth, which a short lapse of time will perhaps develop in all its beauty, and at length place in the possession of every observer of nature.

It may be well to note, that M. Fries draws in the clearest manner a distinction between his *Hysterophyta* or *Fungi*, and the *Protophyta*, which is a natural group consisting of the Linnæan *Algæ* and *Lichenes*. He proves that they form two distinct series of vegetables having analogous exterior forms at their corresponding points. Hence, according to what has preceded, the *Protophyta* and *Fungi* form in the vegetable kingdom two primary groups

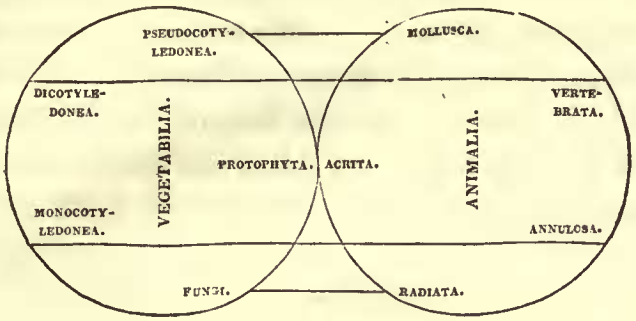
groups of equal degree. In *Protophyta* fructification is secondary, and the thallus essential; whereas in *Fungi* it is quite the reverse. According to our author the first-born of Flora may all be accounted as essentially *roots*, and representing the mode of nutrition; while every fungus is as truly and representatively connected with fructification and reproduction. Throwing aside other considerations, we may perceive the analogous groups of the animal kingdom to be likewise constructed on a similar plan. Each of the *Acrita*, for example, imbibing nourishment at every pore of their surface, internal or external, is essentially a stomach, while the situation of the singular ovaries of the *Radiata* cannot fail to remind us of the importance and position of the sporidia in *Fungi*. The umbellate *Medusa*, the *Echinus*, the *Asterias*, and the *Priapulus* have all their representatives in mycology, of which the genera *Lycoperdon* and *Phallus* are noted instances; so that the analogy of the Radiated animals to *Fungi* is complete; and we thus have in organized matter the following two series of groups connected by affinity and analogous at their corresponding points.

Animalia.	Vegetabilia.
Acrita	Protophyta.
Radiata	Hysterophyta.
Annulosa	Monocotyledonea.
Vertebrata	Dicotyledonea.
Mollusca	Pseudo-cotyledonea? *Agardh**.

Con-

* This last department of the vegetable kingdom, *Pseudo-cotyledonea*, has been defined by M. Agardh in the sixth part of his *Aphorismi Botanici*, which is dated December 1821. According to him it embraces the *Musci*, *Hepaticæ* and *Filices* of Linnæus; and in page 76 of the same work we find a comparison made between these plants and *Amphibia*, which is nevertheless much stronger when applied to them and the *Mollusca*. "Pseudo-cotyledoneæ Amphibiis non dissimiles, humum perreptant vel

Consequently some general idea of the primary distribution of all organized beings may be obtained from the following figure.



To conclude: If an arrangement be natural, it will stand any test; and to support the truth of this proposition, I shall now arrange

vel rimas quærunt, humiditateque gaudent ut illa, organis jam in superiore sectione deperditis iterum instructæ." In these last words he alludes to his own opinion, that Mosses display organs nearly related to the cotyledons of dicotyledonous plants, while the monocotyledonous plants conceal their cotyledon; and if botanists should adopt this opinion, we might assimilate it to the curious fact, that in the animal kingdom the imperfectly organized *Mollusca* display a heart, which is more analogous to that of the *Vertebrata* than the dorsal vessel of insects. With respect, indeed, to the analogies existing between the animal and vegetable kingdoms, they are too striking to have altogether escaped the notice of such an observer as Agardh, who truly observes, "Memorabilis est analogia evolutionis seriei vegetabilis cum animali." When we find him, however, comparing the least perfect vegetables to some of the most perfect animals, the *Algæ* to Fishes, and the *Lichenes* to Insects, we must suspect that he is not sufficiently acquainted with the *evolution* of the animal series, and conclude that he has at least not sufficiently attended to the parallelism of analogy. Nevertheless, his comparison of Monocotyledonous, or, as he terms them, of Cryptocotyledonous Plants to Birds, appears to be a true relation of analogy, although an indirect one; and if he had paid that attention to Entomology which the science really merits, so acute a botanist could not have failed to perceive, that the arguments he gives in support of this last analogy, only receive their full force when they are employed in the comparison of Monocotyledonous Plants with Insects. Thus, in the same page, he states aëriferous cells to be peculiar to Birds in the animal kingdom, evidently not aware that many more animals than are in the whole department of *Vertebrata* would have no means

arrange Annulose Animals in the same way that M. Fries has distributed his Fungi, when it will readily be seen as virtually nothing else than the arrangement I offered to the public in the *Horæ Entomologicæ*. Thus it is only necessary that instead of subjecting Nature to arbitrary rules of our own invention, we should humbly receive her laws as she clearly proclaims them; when she will indeed appear, as M. Fries has found her to be, "ubique varia, semper tamen eadem."

Classification of Annulosa *on the same Principles as those adopted by M. Fries in his natural Distribution of Fungi.*

Annulose Animals, which are not hermaphrodite: or the Annulosa of Scaliger may all be divided into two groups founded on their larva or fœtus state, viz.

1. *Apterous Insects*, having either no metamorphosis in the usual sense of the word, or only that kind of it the tendency of which is confined to an increase in the number of feet.

of getting their fluids aërated did not the air enter their bodies and penetrate through every part of them. But on this head Desfontaines long since set the scientific world at rest, when he established the relation of Dicotyledonous Plants to *Vertebrata*, and of Monocotyledonous Plants to *Annulosa*, not on external appearance merely, but on such primary principles of their respective structures, that we may almost term the former tribe of plants Vertebrated, and the latter Annulose. It would scarcely be fair however towards M. Agardh, did we conceal the fact of his being perfectly aware of the analogies which reign both between the Dicotyledonous Plants and the typical group of *Vertebrata*, and between the *Fungi* and *Radiata*. With respect to this last analogy, indeed, the following words are perhaps more explicit than those previously published, p. 211 of the *Horæ Entomologicæ*—"Fungi superiores animalia Radiata ob figuram radiantem, ob superficiem nudam, ob texturam laxam, ob colorem subsimilem non male revocant."

These

These are the APTERA of Linnæus, and comprehend three classes, viz. *Crustacea*, *Arachnida*, and *Ametabola*, which would be termed *Radii* by M. Fries.

2. *True Insects*, being all subject to that kind of metamorphosis which has a tendency to give wings to the perfect or imago state, but never more than six feet.

These are the PTILOTA of Aristotle, and should, according to M. Fries, be termed the *Centrum* of Annulose Animals. "*Sed centrum abit semper in duas series*," and consequently we find that the

PTILOTA

either become by metamorphosis organized for mastication in their perfect state, and are the	or become by metamorphosis organized for suction in their perfect state, and are the
MANDIBULATA of *Clairville*, which comprise the following orders, viz.	HAUSTELLATA of *Clairville*, which comprise the following orders, viz.
1.	1.
Metamorphosis obtect.	Metamorphosis obtect.
Larvæ eruciform.	Larvæ eruciform.
TRICHOPTERA?	LEPIDOPTERA.
2.	2.
Metamorphosis incomplete, or coarctate.	Metamorphosis incomplete, or coarctate.
Larvæ apod or vermiform.	Larvæ apod or vermiform.
HYMENOPTERA.	DIPTERA.

3. Meta-

3.	3.
Metamorphosis incomplete.	Metamorphosis incomplete.
Larvæ of various types.	Larvæ . . . . .
Coleoptera.	Aptera.
	The only larva of this order known is apod or vermiform, but of the coleopterous structure.
4.	4.
Metamorphosis semicomplete.	Metamorphosis semicomplete.
Larvæ resembling the perfect Insects.	Larvæ resembling the perfect Insects.
Orthoptera.	Hemiptera.
5.	5.
Metamorphosis various.	Metamorphosis various.
Larvæ hexapod.	Larvæ hexapod.
Neuroptera.	Homoptera.

N.B. A mark of doubt is annexed to the word *Trichoptera*, because entomologists have not yet determined whether the Linnæan genus *Phryganea* forms part of an annectent order, or whether it forms a distinct osculant order.

IV. *Some*